**Beta and WACC – Chapt. 13 in RWJJ**



Ct is not known for certain. It is a random variable. It has a probability distribution with a mean and standard deviation.

Ct = E(Ct) = expected cash flow

“r” is the appropriate cost of capital. It should have the same riskiness as Ct

If Ct is a normal extension of the firm’s operations, and the firm is entirely equity financed, we use the stockholders’ required return as found through the CAPM for the appropriate value of ‘r’.

E(Ri) = Rf + βi (Rm – Rf)

Remember: the Beta of security i is the standardized covariance of its returns with the returns on the market portfolio.

βi = Covi,Mkt

σ2Mkt

# Some Determinants of Beta

1. Cyclicality of revenues – How responsive are revenues to changes in the business cycle?

Does the firm produce normal goods or inferior goods?

Highly cyclical ⇒ high covariance with the market ⇒ higher beta.

2. Operating Leverage (Degree of Operating Leverage) – Degree to which costs are fixed.

High FC relative to VC ⇒ high operating leverage

Contribution margin = Price – VC = incremental profit from an additional sale

Low Contribution margin = low FC & high VC = low DOL – example is grocery store

High Contribution margin = high FC & low VC = high DOL – example is airline

High Operating Leverage ⇒ profits are more responsive to changes in sales ⇒ higher beta

3. Financial Leverage – similar to operating leverage if we think of debt as a FC

βEquity = Equity beta = beta of a firm’s stock. This is what we have been measuring and looking at thus far. It is a measure of both the firm’s business risk and its financial risk.

βAsset = Asset beta = weighted average of the betas of all a firm’s securities (common stock, debt and preferred stock – but we will assume the firm has no preferred stock). This is a measure of the firm’s business risk only. It is a measure of the riskiness of the business without including the riskiness of the firm’s financing choice.

βAsset = Debt (βD) + Equity (βE)

D+E D+E

If a firm has no debt, βAsset = βEquity

So, we can think of βAsset as what βEquity would be **if** the firm had no debt – if it is an unlevered firm.

**βEquity is observable and is the beta of the levered firm**

**βAsset is unobservable and is the beta of the unlevered firm**

βD = standardized covariance between the return on a firm’s debt and the market return.

We can calculate βD just as we calculated βE. βD = CovD,Mkt

σ2Mkt

If the debt is risk-free, βD = 0.0 because the covariance of a risk-free asset with anything is zero. Even if the debt is risky, its covariance with the market (and thus its debt beta) will be very low. As a result (and for simplicity), we usually assume that βD = 0.

If βD = 0.0, then βAsset = Equity (βE)

D+E

And,

βEquity = D+E βAsset

E

βEquity = 

This is called the Hamada Equation and it allows us to find the unobservable βAsset if we know the observable βEquity and the firm’s debt-to-equity ratio (capital structure).

If βAsset = beta of an unlevered firm, it doesn’t change as leverage changes, but of course βEquity does.

↑ debt ⇒ ↑ βEquity

The beta of a levered firm equals the beta of an unlevered firm times one plus the D/E ratio. This means that whenever a firm increases its debt, it increases its (observable) beta, increases the risk to the stockholders, and thus increases the return that shareholders require.

If we want to compare the riskiness of two firms that have different amounts of debt, we can’t just look at their observable betas (βEquity) and compare them. We have to ‘unlever’ each firm to find their unobservable betas (βAsset) which can be compared.

Also, if we want to find out what effect a change in the level of debt will have on a firm, we first need to ‘unlever’ the firm to find its unlevered beta, then ‘re-lever’ the firm using the new level of debt to calculate its new (observable) beta and then use that to calculate the new required rate of return for the stockholders.

It is important to note though that the Hamada Equation we just saw ignores the effect of taxes. With the 2018 tax bill, companies with more than $25 million in gross receipts may deduct their interest payments when calculating their federal income tax. For companies with less than $25 million in gross receipts, they may deduct interest payments up to the sum of their business interest income plus 30% of their adjusted taxable income. For our class, we will work with the assumption that a company’s interest payments are tax deductible.

If we want to include the fact that interest payments are tax-deductable to the corporation, we need to modify the Hamada Equation as follows:

βEquity = 

When we add the effect of the tax deductibility of interest expenses, the computations become a tiny bit more complex, but the principles remain the same.

**Example**:

Reese’s Pieces Corp. has a capital structure of 80% equity and 20% debt.

If you do an analysis of its returns vs. the market’s returns for the past five years, you will find that its beta is 0.96. This is the observable βEquity

Suppose the risk-free rate is currently 3% and the market risk-premium is 5.7%.

What is the required return of investors?

According to the CAPM:

E(RRP) = 3% + 0.96 (5.7%) = 8.472%

Now, suppose that Reese’s is considering taking on additional debt that will change its capital structure to 60% equity and 40% debt. How will that change investors’ required rate of return? As we typically do, let’s assume that the Beta of Reese’s debt is zero. Its marginal tax rate is 21%.

First calculate Reese’s Pieces’ unlevered beta (βAsset ):

βEquity = 

βAsset = (βEquity) / 

= (0.96) / (1 + (.79) (.2/.8)) = (0.802)

Next, ‘re-lever’ the firm with its new level of debt.

βEquity = 

= 0.802 (1 + (.79) (.4/.6)) = 1.224

With a new beta of 1.224, the CAPM says that investors require a return of:

E(RRP) = 3% + 1.224 (5.7%) = 9.976%

**Weighted-Average Cost of Capital** - WACC - The expected return on a portfolio of all the firm’s securities. This is the return you would get on your total investment in the company if you owned all its equity and debt.

**WACC** =  + 

This is the required rate of return for the company as a whole. This is also the required rate of return for projects with the same risk as the company as a whole.

**Shareholder’s Required Return** - Expected Rate of Return that stockholders require for investing in this company. - Found by CAPM. E (Ri) = Rf + βi (Rm – Rf) where E(Ri) is the expected return on the firm’s *equity*.

**Bondholder’s Required Return** - Expected Rate of Return Bondholders require for lending money to this company - found by **YTM** (don’t forget how to find it!) Note: Due to default risk, the expected return for the bondholders is actually < YTM.

Price =  Solve for “r” and double it to get YTM

**Value of Debt** - Total dollar amount (market value) of money borrowed by the firm.

Since bank debt is not traded, it may not be possible to determine its

market value. In that case, we usually use the book value of the debt as a proxy for its market value when we can’t determine its market value.

**Value of Equity** - Number of shares outstanding multiplied by current price per share

Note: Same definition for Value of Preferred Stock if there is any

**Value of Company –** Total Market Value of all equity and debt (if you subtract out the

amount of cash, this is called the firm’s Enterprise Value)

**Debt Ratio** - D/V - Value of debt divided by value of company

**Equity Ratio** - E/V - Value of equity divided by value of company

**After-tax Cost of Debt** - (Pretax cost) (1 - tax rate) Note interest payments are

(rdebt ) (1 - t) tax deductible.

With 8% interest rate and 21% tax bracket: 8% (1 - .21) = 6.32%

Note that because debtholders require a lower return than equity-holders, and because interest payments are tax-deductable to the corporation, taking on more debt should lower a firm’s WACC. However, remember that taking on more debt increases a firm’s beta which raises its WACC. To see which effect is more powerful, take some more finance cousres.

**Determining WACC**

**1**. Calculate the value of each security as a proportion of the firm’s value

**2**. Determine the required rate of return on each security

**3**. Calculate a weighted average of the cost of the after-tax return on debt and the return on the stock.

**Example**: Freeman Ind. has the following:

One million shares of common stock outstanding

Current Price = $60.60/share

Publicly traded bonds with a total face value of $20 million. The bonds are currently trading at 101. Their coupon rate is 8% and they mature in 12 years.

Corporate tax rate = 21%

Beta = 1.1

Risk-free rate = 3%

Market Risk Premium = 5.7%

**What is Freeman’s WACC?**

Firm’s Value = Value of Common Stock + Value of Bonds

Value of Common Stock = (1 million) ($60.60) = $60.6 million

Value of Corp Bonds = (1.01) ($20 million) = $20.2 million

Value of Company = $60.6 + $20.2 = $80.8 million

Proportion of Stock Value = $60.6 million = 75%

$80.8 million

Proportion of Debt Value = $20.2 million = 25%

$80.8 million

Required Return of Stock: E(RFreeman) = Rf + βf (Rm – Rf)

= 3% + 1.1 (5.7%)

= 9.27%



Required Return on Bonds is the Yield to Maturity

101 = 

r = 3.93% ⇒ YTM = 7.87%

WACC = .75 (9.27%) + .25 (7.87%) (1 - .21)

= 8.51%

Note: This is the opportunity cost of capital for Freeman. It is the discount value to be used when considering projects that have the same risk as the company.

Why do Common Stockholders require more expected return than Bondholders? Risk.

Question: If Freeman wants to open a new office in New Orleans (with the same risk as the company as a whole), is it a good idea if the free cash flows are:?

Year CF

0 -114 mill.

1 45 mill.

2 45 mill.

3 45 mill.

NPV = -114 + \_\_45\_\_ + \_\_45\_\_ + 45 .

1.0851 (1.0851)2 (1.0851)3

= $917,064 Since it is a Positive NPV we do it.

IRR = 8.95% so we also do it because 8.95% > 8.51%.

So WACC = 8.51% and IRR = 8.95%

WACC is an appropriate discount rate only for a project that is a carbon copy of the firm’s existing business in terms of risk and capital structure.

If a project is more risky, the discount rate must increase

If a project is less risky, the discount rate must decrease

If, to finance a new project, a firm must issue new equity or new debt, the discount rate must be figured based on the new WACC. That is the WACC after the new debt or equity is issued.